UNITED STATES MINERAL PRODUCTS COMPANY

SINCE 1875

General Office and Plant
STANHOPE, NEW JERSEY 07874

Tel 347-1200 Area Code 201
Cable: CAFCOINSUL, New York

June 11, 1970

Mr. R. Monti, Construction Manager
World Trade Center
Port of New York Authority
111 8th Ave.
New York, New York

Subject: Report & Documentation of Health Aspects of CAFCO C/F Fibers

Dear Ray:

This booklet contains all the documents and reference materials listed in our letter of June 8, 1970 to Dr. Rickles, except items 4 and 5, which are not pertinent.

We trust this expert medical opinion and the Mellon Institute x-ray diffraction analysis work will satisfy all parties.

Very truly yours,

Harry S. Gropp
Sales Manager
Architectural Specialty Products

HSG/aq

cc: File

PLAINTIFF'S EXHIBIT PX-614

(412) 687-2100

INDUSTRIAL HYGIENE FOUNDATION OF AMERICA, INC.

5231 CENTRE AVENUE PITTSBURGH, PA. 15232

June 5, 1970

Mr. R. L. Parks
Associate Managing Engineer
Fire Protection Department
Underwriters' Laboratories, Inc.
333 Pfingsten Road
Northbrook, Illinois 60062

Dear Mr. Parks:

In response to a request of one of our members (United States Mineral Products Company), we have reviewed in full the materials used in composition of CAFCO C/F products, with regard to their ability to produce adverse health effects; none of the materials used are considered by us to have pathogenic or toxicological bioeffects in man when used for their intended purpose—i. e., sprayed fiber fireproofing—provided that the degree of dustiness does not exceed the recommended safe threshold for biologically "inert," nuisance dusts in the List of Threshold Limit Values published annually by the American Conference of Governmental Industrial Hygienists (enclosures 1 and 2).

A more detailed report on this subject prepared by Industrial Hygiene Foundation and submitted to Mr. Verhalen, President of United States Mineral Products Company, earlier this week should be available to you upon request; it discusses the basis for considering mineral wool derived from blast furnace slag—a vitreous fiber—as being similar to other noncrystalline materials (e. g. fibrous glass and ceramic aluminum silicate) which have been examined by us and found to be biologically "inert."

Industrial Hygiene Foundation, which has been studying the effects of such dusts on the lung for 35 years (enclosures 3 and 4) will continue its studies, and should any evidence of possible harm to employee or public health from these products be encountered we will notify you—as well as the company and the public—at once in order that timely controls may be instituted. To the best of our

knowledge, however, controls other than for avoidance of nuisance dustiness, in or out of plant, are not required for CAFCO C/F products at this time.

Should questions arise, you may feel free to call Dr. Paul Gross, Director of Industrial Hygiene Foundation's Research Laboratories (412-621-3500, Extension 6111) or me (412-687-2100).

Sincerely yours,

Robert T. P. deTreville, M. D.
President

deT:nf
Enclosures
cc: Mr. J. P. Verhalen

UNITED STATES MINERAL PRODUCTS COMPANY

since 1915

General Office and Plant
STANHOPE, NEW JERSEY 07874

Tel. 347-1200 Area Code 201
Cable: CAFCONSUL, New York

June 8, 1970

Robert N. Rickles, Ph.D., P.E.
Commissioner
The City of New York
Department of Air Resources
51 Astor Place
New York, New York 10003

Dear Dr. Rickles:

In further reply to your letter dated April 29, 1970, and pursuant to our meeting with you at the Office of the Administrator, Environmental Protection Administration, New York City, we are pleased to comply with your request for expert medical opinion on Health Aspects of CAFCO C/F Fibers.

Enclosed you will find the following documents:

1. Report entitled, "Health Aspects of CAFCO C/F Fibers" dated June 4, 1970 by Robert T. P. deTreville, M.D., Sc.D., and Paul Gross, M.D.
2. Biographical sketches of Drs. deTreville and Gross
3. Publication entitled "Fibrous Dust Products and Ferruginous Bodies" by Paul Gross, M.D., and Robert T. P. deTreville, M.D., Sc.D.
4. Publications list of Industrial Hygiene Foundation, Pittsburgh, Pennsylvania
5. 1969 Annual Report of Industrial Hygiene Foundation
6. Threshold Limit Values of Air-Borne Contaminants Adopted by American Conference of Governmental Industrial Hygienists for 1969
7. Report of Committee on Threshold Limits of ACGIH; 1970 Notice of Intended Changes
8. Copy of letter of Industrial Hygiene Foundation of America dated June 5, 1970, addressed to Underwriters' Laboratories, Inc., which has tested and listed CAFCO C/F Fibers.

We believe that the above report and supporting documentation represents the opinion of true medical experts in this specialized field of health aspects of fibrous dust particles. Robert T. P. deTreville, M.D., Sc.D., and Paul Gross, M.D., have authored more than 160 publications in this field and represent the Industrial Hygiene Foundation which has been studying the effects of such dusts for 35 years.

The complete formulas of CAFCO C/F Fibers are known to Drs. deTreville and Gross. Their opinion is based on this knowledge. We are prepared, if required, to similarly divulge these proprietary formulas to members of your Medical Advisory Committee who are not engaged as physicians or consultants to competitors, in return for their simple agreement to keep this information confidential and not to divulge it to others.

If, at any time, our Company became aware of a health hazard existing with its CAFCO C/F products, we would voluntarily notify the users of those products as to the extent of the hazard and the precautions required in their use. Our Company will participate in the on-going Central Depository Project of the Industrial Hygiene Foundation to collect and evaluate data on the industry's employees in future years in both biostatistical studies of employees and retired workers, and pathological studies of lung tissue of former employees and present employees of the industry, as they become available.

To assist in expediting your review of our CAFCO C/F Fibers, we are prepared to answer any questions, submit further information as required, and if necessary, arrange for our medical consultants to meet with your Medical Advisory Committee on this subject.

Very sincerely,

JPV/es
Encl.

J. P. Verhalen,
President

ESTABLISHED 1935

(412) 687-2100

INDUSTRIAL HYGIENE FOUNDATION OF AMERICA, INC.

5231 CENTRE AVENUE PITTSBURGH, PA. 15232

Mr. Chairman, Honorable Members of the Committee, I am Robert T. P. deTreville, M.D., Sc.D., Board Certified in Preventive Medicine (Occupational Medicine) 1957; Fellow of the American College of Physicians, American Academy of Occupational Medicine, Industrial Medical Association and American College of Preventive Medicine; member of the American Medical Association and American Industrial Hygiene Association; and since 1963, President of Industrial Hygiene Foundation of America, Inc. (IHF), a nonprofit, research association of industries for advancement of health protection and conservation and human relations in industry, i.e. in relation to industry's operations, products and wastes.

Originating in Mellon Institute in 1935 to help solve silicosis, the Foundation now occupies its own headquarters in Pittsburgh. Its members number about 400 industrial companies and associations. Its research is conducted in the field, in the Research Laboratory (located within the University of Pittsburgh, Graduate School of Public Health, Department of Occupational Health, as an Industrial Hygiene Research Unit) and the Mellon Institute of Carnegie-Mellon University, where out highly technical analytical studies are conducted. Our work is supported by member dues and by project support from government as well as industry.

Robert T. P. deTreville, M.D., Sc.D.

5/21/70

ESTABLISHED 1935

(412) 687-2100

INDUSTRIAL HYGIENE FOUNDATION OF AMERICA, INC.

5231 CENTRE AVENUE PITTSBURGH, PA. 15232

Mr. Chairman, Honorable Members of the Committee, I am Paul Gross, M.D., Founding Fellow of the College of American Pathologists; Fellow of the American College of Chest Physicians, American College of Physicians, and American Association for the Advancement of Science; member of the American Association of Pathologists and Bacteriologists, American Industrial Hygiene Association, American Medical Association, American Society of Clinical Pathologists, American Society of Experimental Pathologists, American Thoracic Society, Industrial Medical Association, International Academy of Pathology, Society of Experimental Biology and Medicine, American Chemical Society, and American Conference of Governmental Industrial Hygienists (member, Threshold Limits Committee, and Chairman, Diagnostic Criteria and Disability Assessment for the Pneumoconioses Committee); and since 1948, Director of the Industrial Hygiene Foundation of American, Inc. Research Laboratory. Concurrently, I am Research Professor, Pathology of Industrial Diseases, University of Pittsburgh, Graduate School of Public Health, Department of Occupational Health, since 1968, and have authored over 160 publications in the field of pathological research.

IHF is a nonprofit, research association of industries for advancement of health protection and conservation and human relations in industry, i.e., in relation to industry's operations, products and wastes. Originating in

Mellon Institute in 1935 to help solve silicosis, the Foundation now occupies its own headquarters in Pittsburgh. Its members number about 400 industrial companies and associations. Its research is conducted in the field, in the Research Laboratory (located within the University of Pittsburgh, Graduate School of Public Health, Department of Occupational Health as an Industrial Hygiene Research Unit), and the Mellon Institute of Carnegie-Mellon University, where our highly technical analytical studies are conducted. Our work is supported by member dues and by project support from government as well as industry.

Paul Gross, M.D.

5/21/70

Threshold Limit Values of Airborne Contaminants Adopted By ACGIH For 1969

AND INTENDED CHANGES

PREFACE

THRESHOLD LIMIT VALUES FOR 1969

Threshold limit values refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. Because of wide variation in individual susceptibility, however, a small percentage of workers may experience discomfort from some substances at concentrations at or below the threshold limit, a smaller percentage may be affected more seriously by aggravation of a pre-existing condition or by development of an occupational illness.

Simple tests are now available (J. Occup. Med. 9, 537, 1967; Ann. N.Y. Acad. Sci. 151 Art. 2, p. 968, 1968) that may be used to detect those individuals hypersusceptible to a variety of industrial chemicals (respiratory irritants, hemolytic chemicals, organic isocyanates, carbon disulfide). These tests may be used to screen out by appropriate job placement the hyperreactive worker and thus in effect improve this "coverage" of the TLVs.

Threshold limit values refer to time-weighted concentrations for a 7 or 8-hour workday and 40-hour workweek. They should be used as guides in the control of health hazards and should not be used as fine lines between safe and dangerous concentrations. (Exceptions are the substances listed in Appendices A and B and those substances designated with a "C" or Ceiling value, Appendix C.)

Time-weighted averages permit excursions above the limit provided they are compensated by equivalent excursions below the limit during the workday. In some instances it may be permissible to calculate the average concentration for a workweek rather than for a workday. The degree of permissible excursion is related to the magnitude of the threshold limit value of a particular substance as given in Appendix C. The relationship between threshold limit and permissible excursion is a rule of thumb and in certain cases may not apply. The amount by which threshold limits may be exceeded for short periods without injury to health depends upon a number of factors such as the nature of the contaminant, whether very high concentrations - even for short periods - produce acute poisoning, whether the effects are cumulative, the frequency with which high concentrations occur, and the duration of such periods. All factors must be taken into consideration in arriving at decision as to whether a hazardous condition exists.

Threshold limits are based on the best available information from industrial experience, from experimental human and animal studies, and, when possible, from a combination of the three. The basis on which the values are established may differ from substance to substance; protection against impairment of health may be a guiding factor for some, whereas reasonable freedom from irritation, narcosis, nuisance or other forms of stress may form the basis for others.

The committee holds to the opinion that limits based on physical irritation should be considered no less binding than those based on physical impairment. There is no evidence that physical irritation may initiate, promote or accelerate physical impairment through interaction with other chemical or biologic agents.

In spite of the fact that serious injury is not believed likely as a result of exposure to the threshold limit concentrations, the best practice is to maintain concentrations of all atmospheric contaminants as low as is practical.

These limits are intended for use in the practice of industrial hygiene and should be interpreted and applied only by a person trained in this discipline. They are not intended for use, or for modification for use, (1) as a relative index of hazard or toxicity (2) in the evaluation or control of community air pollution or air pollution nuisances, (3) in estimating the toxic potential of continuous uninterrupted exposures, (4) as proof or disproof of an existing disease or physical condition, or (5) for adoption by countries whose working conditions differ from those in the United States of America and where substances and processes differ.

Ceiling vs Time-Weighted Average Limits. Although the time-weighted average concentration provides the most satisfactory, practical way of monitoring airborne agents for compliance with the limits, there are certain substances for which it is inappropriate. In the latter group are substances which are predominantly fast acting and where threshold limit is more appropriately based on this particular response. Substances with this type of response are best controlled by a ceiling "C" limit that should not be exceeded. It is implicit in these definitions that the manner of sampling to determine compliance with the limits for each group must differ; a single brief sample, that is applicable to a "C" limit, is not appropriate to the time-weighted limit. Here, a sufficient number of samples are needed to permit a time-weighted average concentration throughout a complete cycle of operations or throughout the work shift.

Whereas the ceiling limit places a definite boundary which concentrations should not be permitted to exceed, the time-weighted average limit requires an explicit limit to the excursions that are permissible above the listed values. The

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magnitude of these excursions may be pegged to the magnitude of the threshold limit by an appropriate factor shown in Appendix C. It should be noted that the same factors are used by the Committee in making a judgment whether to include or exclude a substance for a "C" listing.

"Skin" Notation. Listed substances followed by the designation "Skin" refer to the potential contribution to the over-all exposure by the cutaneous route including mucous membranes and eye, either by air-borne, or more particularly, by direct contact with the substance. Vehicles can alter skin absorption. This attention-calling designation is intended to suggest appropriate measures for the prevention of cutaneous absorption so that the threshold limit is not invalidated.

Mixtures. Special consideration should be given also to the application of the TLVs in assessing the health hazards which may be associated with exposure to mixtures of two or more substances. A brief discussion of basic considerations involved in developing threshold limit values for mixtures, and methods for their development, amplified by specific examples are given in Appendix B.

"Inert" or Nuisance Particulates. A number of dusts or particulates that occur in the working environment ordinarily produce no specific effects upon prolonged inhalation. Some insoluble substances are classed as inert (e.g. iron and steel dusts, cement, silicon carbide, titanium dioxide, cellulose); others may be soluble (starch, soluble oils, calcium carbonate) but are of such a low order of activity that in concentrations ordinarily encountered do not cause physiologic impairment; still others may be rapidly eliminated or destroyed by the body (vegetable oils, glycerine, sucrose). In the case of the insoluble substances, there may be some accumulation in the respiratory passages. In the case of the soluble substances, this accumulation will ordinarily be temporary but may interfere to some extent with respiratory processes. Hence, it is desirable to control the concentrations of such particulates in the air breathed by any individual, in keeping with good industrial hygiene practice.

A threshold limit of 15mg/M^3, or 50 mpp/cf, of total dust <1% SiO_2, whichever is less, is recommended for substances in these categories and for which no specific threshold limits have been assigned. This limit, for a normal workday, does not apply to brief exposures at higher concentrations. Neither does it apply to those substances which may cause physiologic impairment at lower concentrations but for which a threshold limit has not yet been adopted. Some "inert" particulates are given in Appendix D.

Simple Asphyxiants - "Inert" Gases or Vapors. A number of gases and vapors, when present in high concentrations in air, act primarily as simple asphyxiants without other significant physiologic effects. A TLV may not be recommended for each simple asphyxiant because the limiting factor is the available oxygen. The minimal oxygen content should be 18 percent by volume under normal atmospheric pressure (equivalent to a partial pressure, pO_2 of 135 mm Hg). Atmospheres deficient in O_2 do not provide adequate warning and most simple asphyxiants are odorless. Several simple asphyxiants present an explosion hazard. Account should be taken of this factor in limiting the concentration of the asphyxiant. Specific examples are listed in Appendix E.

Physical Factors. It is recognized that such physical factors as heat, ultraviolet and ionizing radiation, humidity, abnormal pressure (altitude) and the like may place added stress on the body so that the effects from exposure at a threshold limit may be altered. Most of these stresses act adversely to increase the toxic response of a substance. Although most threshold limits have built-in safety factors to guard against adverse effects to moderate deviations from normal environments, the safety factors of most substances are not of such a magnitude as to take care of gross deviations. For example, continuous work at temperatures above 90°F or over-time extending the workweek more than 25%, might be considered gross deviations. In such instances judgment must be exercised in the proper adjustments of the threshold limit values.

"Notice of Intent" At the beginning of each year, proposed actions of the Committee for the forthcoming year are issued in the form of a "Notice of Intent." This Notice provides not only an opportunity for comment, but solicits suggestions of substances to be added to the list. The suggestions should be accompanied by substantiating evidence.

As Legislative Code. Although the Conference does not consider the TLVs appropriate matter for adoption into legislative codes and regulations, it recognizes that the values may be so used. If so used, the intent of the concepts contained in the Preface should be maintained and provisions should be made to keep the list current. These values are reviewed annually by the Committee on Threshold Limits for revision or additions, as further information becomes available.

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ADOPTED VALUES
(In Alphabetical Order)

Substance	ppm[a]	mg/M^3 [b]	Notes
*Abate	-	15	
Acetaldehyde	200	360	
Acetic acid	10	25	
Acetic anhydride	5	20	
Acetone	1,000	2,400	
Acetonitrile	40	70	
Acetylene dichloride, see 1, 2 Dichloroethylene			
Acetylene tetrachloride	1	14	
Acrolein	0.1	0.25	
Acrylamide-skin	-	0.3	
Acrylonitrile-Skin	20	45	
Aldrin-Skin	-	0.25	
Allyl alcohol-Skin	2	5	
Allyl chloride	1	3	
C Allyl glycidyl ether (AGE)	10	45	
Allyl propyl disulfide	2	12	
2-Aminoethanol, see Ethanolamine			
2-Aminopyridine	0.5	2	
** Ammonia	50	35	
Ammonium sulfamate (Ammate)	-	15	
n-Amyl acetate	100	525	
sec-Amyl acetate	125	650	
Aniline-Skin	5	19	
Anisidine (o, p-isomers)-Skin	-	0.5	
Antimony & compounds (as Sb)	-	0.5	
ANTU (alpha naphthyl thiourea)	-	0.3	
Arsenic & Compounds (as As)	-	0.5	
Arsine	0.05	0.2	
Azinphos-methyl-Skin	-	0.2	
Barium (soluble compounds)	-	0.5	
C Benzene (benzol)-Skin	25	80	
Benzidine-Skin	-	A1	
p-Benzoquinone, see Quinone			
Benzoyl peroxide	-	5	
Benzyl chloride	1	5	
Beryllium	-	0.002	
Biphenyl, see Diphenyl			
Boron oxide	-	15	
* Boron trifluoride	1	-	

a) Parts of vapor or gas per million parts of contaminated air by volume at 25°C and 760 mm. Hg pressure.

b) Approximate milligrams of particulate per cubic meter of air.

A Numbers, See Appendix A

* 1969 Addition

** See Notice of Intended Changes

Substance	ppm[a]	mg/m³ [b]
C Boron trifluoride	1	3
Bromine	0.1	0.7
* Bromine pentafluoride	0.1	-
Bromoform-Skin	0.5	5
Butadiene (1, 3-butadiene)	1,000	2,200
Butanethiol, see Butyl mercaptan		
2-Butanone	200	590
2-Butoxy ethanol (Butyl Cellosolve) Skin	50	240
Butyl acetate (n-butyl acetate)	150	710
n-Butyl acetate	150	710
sec-Butyl acetate	200	950
tert-Butyl acetate	200	950
Butyl alcohol	100	300
sec-Butyl alcohol	150	450
tert. Butyl alcohol	100	300
C Butylamine-Skin	5	15
C tert. Butyl chromate (as CrO3) - Skin	-	0.1
n-Butyl glycidyl ether (BGE)	50	270
** Butyl mercaptan	10	35
p-tert. Butyltoluene	10	60
Cadmium (Metal dust and soluble salts)	-	0.2
** Cadmium oxide fume	-	0.1
Calcium arsenate	-	1
Calcium oxide	-	5
* Camphor	2	-
Carbaryl (Sevin ®)	-	5
Carbon black	-	3.5
Carbon dioxide	5,000	9,000
Carbon disulfide-Skin	20	60
Carbon monoxide	50	55
Carbon tetrachloride-Skin	10	65
Chlordane-Skin	-	0.5
Chlorinated camphene, - Skin	-	0.5
Chlorinated diphenyl oxide	-	0.5
*Chlorine	1	-
Chlorine dioxide	0.1	0.3
C Chlorine trifluoride	0.1	0.4
C Chloroacetaldehyde	1	3
α-Chloroacetophenone (phenacyl-chloride)	0.05	0.3
Chlorobenzene (monochlorobenzene)	75	350
o-Chlorobenzylidene malononitrile (OCBM)	0.05	0.4
Chlorobromomethane	200	1,050
2-Chloro-1, 3 butadiene, see Chloroprene		
Chlorodiphenyl (42% Chlorine) - Skin	-	1

** See Notice of Intended Changes

Substance	ppm[a]	mg/m³ [b]
Chlorodiphenyl (54% Chlorine) - Skin	-	0.5
1, Chloro, 2, 3 epoxypropane, see Epichlorhydrin		
2, Chloroethanol, see Ethylene chlorohydrin		
Chloroethylene, see Vinyl chloride.		
C Chloroform (trichloromethane)	50	240
1-Chloro-1-nitropropane	20	100
Chloropicrin	0.1	0.7
Chloroprene (2-chloro-1, 3-butadiene)-Skin	25	90
Chromic acid and chromates (as CrO_3)	-	0.1
Chromium, sol. chromic, chromous salts as Cr	-	0.5
Metal & insol. salts	-	1
Coal tar pitch volatiles (benzene soluble fraction) anthracene, BaP, phenanthrene, acridine, chrysene, pyrene)	-	0.2
Cobalt, metal fume & dust	-	0.1
Copper fume	-	0.1
Dusts and Mists	-	1
Cotton dust (raw)	-	1
Crag ® herbicide	-	15
Cresol (all isomers) - Skin	5	22
Crotonaldehyde	2	6
Cumene-Skin	50	245
Cyanide (as CN)-Skin	-	5
* Cyanogen	10	-
Cyclohexane	300	1,050
Cyclohexanol	50	200
Cyclohexanone	50	200
Cyclohexene	300	1,015
Cyclopentadiene	75	200
2, 4-D	-	10
DDT-Skin	-	1
DDVP-Skin	-	1
Decaborane-Skin	0.05	0.3
Demeton ® -Skin	-	0.1
Diacetone alcohol (4-methyl-2-pentanone)	50	240
1, 2 Diaminoethane, see Ethylenediamine Diazomethane	0.2	0.4
Diborane	0.1	0.1
C 1, 2-Dibromoethane (ethylene dibromide)-Skin	25	190
Dibutyl phosphate	1	5
Dibutylphthalate	-	5
C o-Dichlorobenzene	50	300
p-Dichlorobenzene	75	450

** See Notice of Intended Changes

Substance	ppm[a]	mg/m³ [b]
Dichlorodifluoromethane	1,000	4,950
1, 3-Dichloro-5, 5-dimethyl hydantoin	-	0
1, 1-Dichloroethane	100	400
1, 2-Dichloroethane	50	200
1, 2-Dichloroethylene	200	790
C Dichloroethyl ether-Skin	15	90
Dichloromethane, see Methylene-chloride		
Dichloromonofluoromethane	1,000	4,200
C 1, 1-Dichloro-1-nitroethane	10	60
1, 2-Dichloropropane, see Propylenedichloride		
Dichlorotetrafluoroethane	1,000	7,000
Dieldrin-Skin	-	0.25
Diethylamine	25	75
Diethylamino ethanol-Skin	10	50
*C Diethylene triamine-Skin	10	-
Diethylether, see Ethyl ether		
Difluorodibromomethane	100	860
C Diglycidyl ether (DGE)	0.5	2.8
Dihydroxybenzene, see Hydroquinone		
Diisobutyl ketone	50	290
Diisopropylamine-Skin	5	20
* Diphenyl amine	-	10
Dimethoxymethane, see Methylal		
Dimethyl acetamide-Skin	10	35
Dimethylamine	10	18
Dimethylanilene, see Xylidene		
Dimethylaniline (N-dimethylaniline)-Skin	5	25
Dimethylbenzene, see Xylene		
Dimethyl 1, 2-dibromo-2, 2-dichloroethyl phosphate, (Dibrom)	-	3
Dimethylformamide-Skin	10	30
2, 6 Dimethylheptanone, see Diisobutyl ketone		
1, 1-Dimethylhydrazine-Skin	0.5	1
Dimethylphthalate	-	5
Dimethylsulfate-Skin	1	5
Dinitrobenzene (all isomers)-Skin	-	1
Dinitro-o-cresol-Skin	-	0.2
Dinitrotoluene-Skin	-	1.5
Dioxane (Diethylene dioxide)-Skin	100	360
Diphenyl	0.2	1
*Diphenyl Amine	-	10
Diphenylmethane diisocyanate (see Methylene bisphenyl isocyanate (MDI)		

* 1969 Addition

Substance	ppm[a]	mg/M³ [b]
Dipropylene glycol methyl ether-Skin	100	600
Di-sec. octyl phthalate (Di-2-ethylhexylphthalate	-	5
Endrin-Skin	-	0.1
Epichlorhydrin-Skin	5	19
EPN-Skin	-	0.5
1,2-Epoxypropane, see Propylene-oxide		
2,3-Epoxy-1-propanol, see Glycidol		
Ethanethol, see Ethylmercaptan		
Ethanolamine	3	6
2 Ethoxyethanol-Skin	200	740
2 Ethoxyethylacetate (Cellosolve acetate)-Skin	100	540
Ethyl acetate	400	1,400
Ethyl acrylate-Skin	25	100
Ethyl alcohol (ethanol)	1,000	1,900
Ethylamine	10	18
Ethyl sec-amyl ketone (5-methyl-3-heptanone)	25	130
Ethyl benzene	100	435
Ethyl bromide	200	890
Ethyl butyl ketone (3-Heptanone)	50	230
Ethyl chloride	1,000	2,600
Ethyl ether	400	1,200
Ethyl formate	100	300
Ethyl mercaptan	10	25
Ethyl silicate	100	850
Ethylene chlorohydrin-Skin	5	16
Ethylenediamine	10	25
Ethylene dibromide, see 1,2-Dibromoethane		
Ethylene dichloride, see 1,2-Dichloroethane		
Ethylene glycol dinitrate and/or Nitroglycerin-Skin	0.2[d]	1
Ethylene glycol monomethyl ether acetate, see Methyl cellosolve acetate		
Ethylene imine-Skin	0.5	1
Ethylene oxide	50	90
Ethylidine chloride, see 1,1-Dichloroethane		
N-Ethylmorpholine-Skin	20	94
Perlam	-	15
Ferrovanadium dust	-	1
Fluoride (as F)	-	2.5
Fluorine	0.1	0.2
Fluorotrichloromethane	1,000	5,600
Furfuraldehyde	5	6

[a] An atmospheric concentration of not more than 0.02 ppm, or personal protection may be necessary to avoid headache

Substance	ppm[a]	mg/M³ [b]
Formic acid	5	9
Furfural-Skin	5	20
Furfuryl alcohol	50	200
Gasoline	-	A[3]
Glycidol (2,3-Epoxy-1-propanol)	50	150
Glycol monoethyl ether, see 2-Ethoxyethanol		
Guthion,[c5] see Azinphosmethyl		
Hafnium	-	0.5
Heptachlor-Skin	-	0.5
** Heptane (n-heptane)	500	2,000
Hexachloroethane-Skin	1	10
Hexachloronaphthalene-Skin	-	0.2
Hexane (n-hexane)	500	1,800
2-Hexanone	100	410
Hexone	100	410
sec-Hexyl acetate	50	300
Hydrazine-Skin	1	1.3
Hydrogen bromide	3	10
C Hydrogen chloride	5	7
Hydrogen cyanide-Skin	10	11
Hydrogen fluoride	3	2
** Hydrogen peroxide, 90%	1	1.4
Hydrogen selenide	0.05	0.2
Hydrogen sulfide	10	15
Hydroquinone	-	2
* Indium and compounds, as In	-	0.1
C Iodine	0.1	1
Iron oxide fume	-	10
* Iron salts, soluble, as Fe	-	1
Isoamyl acetate	100	525
Isoamyl alcohol	100	360
Isobutyl acetate	150	700
Isobutyl alcohol	100	300
Isophorone	25	140
Isopropyl acetate	250	950
Isopropyl alcohol	400	980
Isopropylamine	5	12
Isopropylether	500	2,100
Isopropyl glycidyl ether (IGE)	50	240
Ketene	0.5	0.9
Lead	-	0.2
Lead arsenate	-	0.15
Lindane-Skin	-	0.5
Lithium hydride	-	0.025
L. P. G. (Liquified petroleum gas)	1,000	1,800
Magnesium oxide fume	-	15
Malathion-Skin	-	15
Maleic anhydride	0.25	1
C Manganese	-	5
** Mercury-Skin	-	0.1

* 1969 Addition

** See Notice of Intended Change

Substance	ppm[a]	mg/M³ [b]
** Mercury (organic compounds)-Skin	--	0.01
Mesityl oxide	25	100
Methanethiol, see Methyl mercaptan		
Methoxychlor	--	15
2-Methoxyethanol, see Methyl cellosolve		
Methyl acetate	200	610
Methyl acetylene (propyne)	1,000	1,650
Methyl acetylene-propadiene mixture (MAPP)	1,000	1,800
Methyl acrylate-Skin	10	35
Methylal (dimethoxymethane)	1,000	3,100
Methyl alcohol (methanol)	200	260
Methylamine	10	12
Methyl amyl alcohol, see Methyl isobutyl carbinol		
Methyl (n-amyl) ketone (2-Heptanone)	100	465
C Methyl bromide-Skin	20	80
Methyl butyl ketone, see 2-Hexanone		
Methyl cellosolve-Skin	25	80
Methyl cellosolve acetate-Skin	25	120
C Methyl chloride	100	210
Methyl chloroform	350	1,900
Methylcyclohexane	500	2,000
Methylcyclohexanol	100	470
o-Methylcyclohexanone-Skin	100	460
Methyl ethyl ketone (MEK), see 2-Butanone		
Methyl formate	100	250
Methyl iodide - Skin	5	28
Methyl isobutyl carbinol-Skin	25	100
Methyl isobutyl ketone, see Hexone		
Methyl isocyanate - Skin	0.02	0.05
**C Methyl mercaptan	10	20
Methyl methacrylate	100	410
Methyl propyl ketone, see 2-Pentanone		
*C Methyl silicate	5	--
C α Methyl styrene	100	480
C Methylene bisphenyl isocyanate (MDI)	0.02	0.2
Methylene chloride (dichloromethane)	500	1,740
Molybdenum (soluble compounds)	-	5
(insoluble compounds)	-	15
Monomethyl aniline-Skin	2	9
C Monomethyl hydrazine-Skin	0.2	0.35
Morpholine-Skin	20	70
Naphtha (coal tar)	100	400

* 1969 Addition

Substance	ppm[a]	mg/m³ [b]
Naphthalene	10	50
β-Naphthylamine	-	A[1]
Nickel carbonyl	0.001	0.007
Nickel, metal and soluble cmpds.	-	1
Nicotine-Skin	-	0.5
Nitric acid	2	5
Nitric oxide	25	30
p-Nitroaniline-Skin	1	6
Nitrobenzene-Skin	1	5
p-Nitrochloro-benzene-Skin	-	1
Nitroethane	100	310
C Nitrogen dioxide	5	9
Nitrogen Trifluoride	10	29
C Nitroglycerin-Skin	0.2	2
Nitromethane	100	250
1-Nitropropane	25	90
2-Nitropropane	25	90
N-Nitrosodimethyl-amine (Dimethyl-nitrosoamine)-Skin	-	A[1]
Nitrotoluene-Skin	5	30
Nitrotrichloromethane, see Chloropicrin		
Octachloronaphthalene-Skin	-	0.1
** Octane	500	2,350
** Oil mist (mineral)	-	5
Osmium tetroxide	-	0.002
Oxalic acid	-	1
Oxygen difluoride	0.05	0.1
** Ozone	0.1	0.2
Paraquat-Skin	-	0.5
Parathion-Skin	-	0.1
Pentaborane	0.005	0.01
Pentachloronaphthalene-Skin	-	0.5
Pentachlorophenol-Skin	-	0.5
** Pentane	1,000	2,950
2-Pentanone	200	700
Perchloroethylene	100	670
Perchloromethyl mercaptan	0.1	0.8
Perchloryl fluoride	3	13.5
** Petroleum Distillates (naphtha)	500	2,000
Phenol-Skin	5	19
p-Phenylene diamine-Skin	-	0.1
Phenyl ether (vapor)	1	7
Phenyl ether-Biphenyl mixture (vapor)	1	7
Phenylethylene, see Styrene		
Phenyl glycidyl ether (PGE)	10	60
Phenylhydrazine-Skin	5	22
Phosdrin (Mevinphos)[c] -Skin	-	0.1
Phosgene (carbonyl chloride)	0.1	0.4
Phosphine	0.3	0.4

** See Notice of Intended Changes

Substance	ppm[a]	mg/m³ [b]
Phosphoric acid	-	1
Phosphorus (yellow)	-	0.1
Phosphorus pentachloride	-	1
Phosphorus pentasulfide	-	1
Phosphorus trichloride	0.5	3
Phthalic anhydride	2	12
Picric acid-Skin	-	0.1
Pival[c] (2-Pivalyl-1,3-indandione)	-	0.1
Platinum (Soluble Salts)	-	0.002
Polytetrafluoroethylene decomposition products	-	A[2]
Propane	1,000	1,800
β Propiolactone	-	A[1]
* Propargyl alcohol-Skin	1	-
n-Propyl acetate	200	840
Propyl alcohol	200	500
n-Propyl nitrate	25	110
Propylene dichloride	75	350
Propylene imine-Skin	2	5
Propylene oxide	100	240
Propyne, see Methylacetylene		
Pyrethrum	-	5
Pyridine	5	15
Quinone	0.1	0.4
* RDX-Skin	-	1.5
Rhodium, Metal fume and dusts	-	0.1
Soluble salts	-	0.001
Ronnel	-	15
Rotenone (commercial)	-	5
Selenium compounds (as Se)	-	0.2
Selenium hexafluoride	0.05	0.4
Silver, metal and soluble compounds	-	0.01
Sodium fluoroacetate (1080)-Skin	-	0.05
Sodium hydroxide	-	2
Stibine	0.1	0.5
** Stoddard solvent	500	2,900
Strychnine	-	0.15
**C Styrene monomer (phenylethylene)	100	420
Sulfur dioxide	5	13
Sulfur hexafluoride	1,000	6,000
Sulfuric acid	-	1
Sulfur monochloride	1	6
Sulfur pentafluoride	0.025	0.025
Sulfuryl fluoride	5	20
Systox, see Demeton[c]		
2,4,5 T	-	10
Tantalum	-	5
TEDP-Skin	-	0.2
Teflon[d] decomposition products	-	A[1]
Tellurium	-	0.1

* 1969 Addition

Substance	ppm[a]	mg/m³ [b]
Tellurium hexafluoride	0.02	0.2
TEPP - Skin	-	0.05
C Terphenyls	1	9
1, 1, 1, 2-Tetrachloro-2, 2-difluoroethane	500	4,170
1, 1, 2, 2-Tetrachloro-1, 2-difluoroethane	500	4,170
1, 1, 2, 2-Tetrachloroethane-Skin	5	35
Tetrachloroethylene, see Perchloroethylene		
Tetrachloromethane, see Carbon tetrachloride		
Tetrachloronaphthalene - Skin	-	2
** Tetraethyl lead (as Pb) - Skin	-	0.075
Tetrahydrofuran	200	590
** Tetramethyl lead (TML) (as Pb) - Skin	-	0.075
Tetramethyl succinonitrile - Skin	0.5	3
Tetranitromethane	1	8
Tetryl (2, 4, 6-Trinitrophenylmethylnitramine) - Skin	-	1.5
Thallium (soluble compounds) - Skin	-	0.1
Thiram	-	5
Tin (inorganic cmpds, except SnH_4 and SnO_2)	-	2
Tin (organic cmpds)	-	0.1
Titanium dioxide	-	15
Toluene (toluol)	200	750
C Toluene-2, 4-diisocyanate	0.02	0.14
o-Toluidine - Skin	5	22
Toxaphene, see Chlorinated camphene		
Tributyl phosphate	-	5
1, 1, 1-Trichloroethane, see Methyl chloroform		
1, 1, 2-Trichloroethane - Skin	10	45
Trichloroethylene	100	535
Trichloromethane, see Chloroform		
Trichloronaphthalene - Skin	-	
1, 2, 3-Trichloropropane	50	300
1, 1, 2-Trichloro 1, 2, 2-trifluoroethane	1,000	7,600
Triethylamine	25	100
Trifluorobromomethane	1,000	6,100
2, 4, 6-Trinitrophenol see Picric acid		
2, 4, 6-Trinitrophenylmethylnitramine, see Tetryl		
Trinitrotoluene - Skin	-	1.5
Triorthocresyl phosphate	-	0.1

** See Notice of Intended Changes

Substance	ppm[e]	mg/M³ [b]
Triphenyl phosphate	-	3
* Tungsten & Compounds, as W		
Soluble	-	1
Insoluble	-	5
Turpentine	100	560
* Uranium (natural) sol. & insol. compounds as U	-	0.2
C Vanadium (V_2O_5 dust)	-	0.5
(V_2O_5 fume)	-	0.1
Vinyl benzene, see Styrene		
C Vinyl chloride	500	1,300
Vinylcyanide, see Acrylonitrile		
Vinyl toluene	100	480
Warfarin	-	0.1
Xylene (xylol)	100	435
Xylidine - Skin	5	25
Yttrium	-	1
Zinc chloride fume	-	1
Zinc oxide fume	-	5
Zirconium compounds (as Zr)	-	5

Radioactivity. For permissible concentrations of radioisotopes in air, see U.S. Department of Commerce, National Bureau of Standards, Handbook 69, "Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure," June 5, 1959. Also, see U.S. Department of Commerce National Bureau of Standards, Handbook 59, "Permissible Dose from External Sources of Ionizing Radiation," September 24, 1954, and addendum of April 15, 1958.

* 1969 Addition

MINERAL DUSTS

Substance	m.p.p.c.f.[e]
SILICA	
Crystalline	
** Quartz, Threshold Limit calculated from the formula	$\frac{250}{\%SiO_2 + 5}$ [f]
** Cristobalite " " "	
Amorphous, including natural diatomaceous earth	20
SILICATES (less than 1% crystalline silica)	
** Asbestos	5
Mica	20
Soapstone	20
Talc	20
Tremolite	5
Portland Cement	50
GRAPHITE (natural)	15
"Inert" or Nuisance Particulates see Appendix D	50 (or 15 mg/M³ whichever is the smaller) of total dust < 1% SiO_2

Conversion factors

mppcf x 35.3 = million particles per cubic meter = particles per c.c.

5 mppcf x 35.3 = 176.5 ppcc

** Document attached.

e) Millions of particles per cubic foot of air, based on impinger samples counted by light-field technics.

f) The percentage of crystalline silica in the formula is the amount determined from air-borne samples, except in those instances in which other methods have been shown to be applicable.

** See Notice of Intended Changes

NOTICE OF INTENDED CHANGES

These substances, with their corresponding values, comprise those for which either a limit has been proposed for the first time, or for which a change in the "Adopted" listing has been proposed. In both cases, the proposed limits should be considered trial limits that will remain in the listing for a period of at least two years. During this time, the previously Adopted Limit will remain in effect. If, after two years no evidence comes to light that questions the appropriateness of the values herein, the values will be placed in the "Adopted" list. Documentation is available for each of these substances.

Substance	ppm[a]	mg/M³ [b]
* C Ammonia	50	35
* * 2-Acetylaminofluorene	-	A[3]
* * 4-Aminodiphenyl	-	A[3]
* * Ammonium chloride fume	-	10
* * Asphalt (Petroleum) fumes	-	2
Butyl mercaptan	0.5	-
C Cadmium oxide fume (as Cd)	-	0.1
C Dichloroacetylene	0.1	-
* * Dichlorobenzidine	-	A[3]
* * 4-Dimethylaminoazobenzene	-	A[3]
Endosulfan (Thiodan®) - Skin	-	0.1
Ethyl mercaptan	0.5	-
* Fibrous glass [g]	-	Appendix C
Heptane	500	2,000
* Hydrogen peroxide	1	1
Indene	10	-
* Mercury vapor, inorganic and organic cmpds, excluding alkyl Mercury - Skin	-	0.1
* Methyl 2-cyanoacrylate	2	-
* Methyl demeton - Skin	-	0.5
Methyl isoamyl ketone	100	475
Methyl mercaptan	0.5	-
* * Methyl parathion - Skin	-	0.2
* * 4-Dimethylaminoazobenzene	-	A[3]
Octane	400	1,900
Oil mist (particulate)	-	5
Oil vapors	[h]	A[3]
Pentaerythritol (tetramethylolmethane)	-	10
Pentane	500	1,500

a) Parts of vapor or gas per million parts of contaminated air by volume at 25°C and 760 mm. Hg. pressure.

b) Approximate milligrams of particulate per cubic meter.

* 1969 Revision

** 1969 Addition

Substance	ppm[a]	mg/M³ [b]
Petroleum distillates	[1] A³	-
• Phenothiazine - Skin	-	5
Stoddard Solvent	200	-
• Styrene	100	-
Tetraethyl lead (as Pb) - Skin	-	0.100[j]
Tetramethyl lead (as Pb) - Skin	-	0.150[j]
Trimethyl benzene	25	-
•• Vinyl acetate	10	-
•• Wood Dust (total dust)	-	10

[a] ~5.1 μ Diameter. No TLV for coarse fibrous glass has yet been set.

[b] As sampled by method that does not collect vapors.

[c] According to analytically determined composition.

[j] For control of general room air, biologic monitoring is essential for personnel control.

• 1969 Revision

•• 1969 Addition

NOTICE OF INTENDED CHANGES (Continued)

MINERAL DUST

Substance	
Asbestos	12 fibers/ml - 5μ in length[k], or 2 mppcf[m]
•• Coal Dust (bituminous)	3.5 mg/M³ (respirable dust) [n]
Cristobalite	Use one-half the value calculated from the count or mass formulae for quartz.
Quartz	(1) TLV for respirable dust in mg/M³: [p] $\frac{10\ mg/M^3}{\%\ Respirable\ Quartz + 2}$
	(2) "Total dust" respirable and nonrespirable: $\frac{30\ mg/M^3}{\%\ Quartz + 2}$
•• Fused Silica	Use quartz formulae.
Tridymite	Use one-half the value calculated from formulae for quartz.

[k] As determined by the membrane filter method at 430 × phase contrast magnification.

[m] As counted by the standard impinger, light-field count technique.

[n] "Respirable" dust as defined by the British Medical Research Council Criteria [1] and as sampled by a device producing equivalent results [2].

(1) Rich, T.E. and Gross, P., Pulmonary Deposition and Retention of Inhaled Aerosols, p. 149, Academic Press, New York, New York, 1964.

(2) Interim Guide for Respirable Mass Sampling, ARIA Aerosol Technology Committee, in draft form, to be published in late 1969.

[p] Both concentration and per cent quartz for the application of this limit are to be determined from the fraction passing a size-selector with the following characteristics:

Aerodynamic Diameter (•) (unit density sphere)	% passing selector
2	90
2.5	75
3.5	50
5.0	25
10	0

• 1969 Revision

•• 1969 Addition

APPENDIX A

A1 Because of the high incidence of cancer, either in man or in animals, no exposure or contact by any route, respiratory, oral or skin should be permitted to the compounds

2-Acetylaminofluorene	Ethyleneimine
4-Aminodiphenyl	3-Methylcholanthrene
Benzidine & its salts	N-Nitrosodimethylamine
Dichlorobenzidine	beta-Propiolactone
4-Dimethylaminoazobenzene	

Because of the extremely high incidence of bladder tumors in workers handling beta-naphthylamine and its potential carcinogenic activity of the other compounds, the State of Pennsylvania prohibits the manufacture, use and other activities that involve human exposure without express approval by the Department of Health.

A2 Polytetrafluoroethylene* decomposition products. Thermal decomposition of the fluorocarbon chain leads to the formation of oxidized products containing carbon, fluorine and oxygen, because these products decompose in part by hydrolysis in alkaline solution, they can be quantitatively determined in air as fluorides to provide an index of exposure. No TLV is recommended pending determination of the toxicity of the products, but air concentrations should be minimized.

A3 Gasoline and/or Petroleum Distillates. The composition of these materials varies greatly and thus a single TLV for all types of these materials is no longer applicable. In general, the aromatic hydrocarbon content will determine what TLV applies. Consequently the content of benzene, other aromatics and additives should be determined to arrive at the appropriate TLV (Elkins, et al, A.I.H.A.J. 24, 99, 1963).

*Trade Names Algoflon, Fluon, Halon, Teflon, Tetran

APPENDIX B

B.1 THRESHOLD LIMIT VALUES FOR MIXTURES

When two or more hazardous substances are present their combined effect, rather than that of either substance individually, should be given primary consideration. In the absence of information to the contrary, the effects of different hazards should be considered as additive. That is, if the sum of the following fractions,

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \cdots\cdots \frac{C_n}{T_n}$$

exceeds unity, then the threshold limit of the mixture should be considered as being exceeded, C_1 indicates the observed atmospheric concentration, and T_1 the corresponding threshold limit, (See Example 1A.a.).

Exceptions to the above rule may be made when there is good reason to believe that the chief effects of the different harmful substances are not in fact additive, but independent as when purely local effects on different organs of the body are produced by the various components of the mixture. In such cases the threshold limit of harmful is exceeded only when at least one member of the series $\frac{C_1}{T_1}$ or $\frac{C_2}{T_2}$ etc., itself has a value exceeding unity. (See Example 1A.b.).

Antagonistic action or potentiation may occur with some combinations of atmospheric contaminants. Such cases at present must be determined individually. Potentiating or antagonistic agents are not necessarily harmful by themselves. Potentiating effects of exposure to such agents by routes other than that of inhalation is also possible, e.g. imbibed alcohol and inhaled narcotic (trichloroethylene). Potentiation is characteristically exhibited at high concentrations, less probably at low.

When a given operation or process characteristically emits a number of harmful dusts, fumes, vapors or gases, it will frequently be only feasible to attempt to evaluate the hazard by measurement of a single substance. In such cases, the threshold limit used for this substance should be reduced by a suitable factor, the magnitude of which will depend on the number, toxicity and relative quantity of the other contaminants ordinarily present.

Examples of processes which are typically associated with two or more harmful atmospheric contaminants are welding, automobile repair, blasting, painting, lacquering, certain foundry operations, diesel exhausts, etc. (Example 2.)

THRESHOLD LIMIT VALUES FOR MIXTURES EXAMPLES

1A. General case, where air is analyzed for each component.

a. ADDITIVE EFFECTS

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \frac{C_3}{T_3} + \cdots \frac{C_n}{T_n} = 1$$

Air contains 5 ppm of carbon tetrachloride (TLV, 10), 20 ppm of ethylene dichloride (TLV, 50) and 10 ppm of ethylene dibromide, (TLV, 25).

$$\frac{5}{10} + \frac{20}{50} + \frac{10}{25} = \frac{65}{50} = 1.3$$

Threshold limit is exceeded.

b. INDEPENDENT EFFECTS

Air contains 0.15 mg/M^3 of lead (TLV, 0.2) and 0.7 mg/M^3 of sulfuric acid (TLV, 1).

$$\frac{0.15}{0.20} = 0.75; \qquad \frac{0.7}{1} = 0.7$$

Threshold limit is not exceeded.

1B. Special case when source of contaminant is a mixture and atmospheric composition is assumed similar to that of original material, i.e. vapor pressure of each component is the same at the observed temperature.

a. ADDITIVE EFFECTS, approximate solution.

1. A mixture of equal parts (1) trichloroethylene (TLV, 100), and (2) methyl chloroform (TLV, 350).

$$\frac{C_1}{100} + \frac{C_2}{350} = \frac{C_m}{T_m}$$

Solution applicable to "spot" solvent mixture usage, where all or nearly all, solvent evaporates.

$$C_1 = C_2 = \frac{1}{2} C_m$$

$$\frac{C_1}{100} + \frac{C_1}{350} = \frac{2C_1}{T_m}$$

$$\frac{7C_1}{700} + \frac{2C_1}{700} = \frac{2C_1}{T_m}$$

$$T_m = 700 \times \frac{2}{9} = 155 \text{ ppm}$$

1B. b General Exact Solution for Mixtures of N Components With Additive Effects and Different Vapor Pressures

(1) $\frac{C_1}{T_1} + \frac{C_2}{T_2} + \cdots + \frac{C_n}{T_n} = 1.$

(2) $C_1 + C_2 + \cdots + C_n = T.$

(2.1) $\frac{C_1}{T} + \frac{C_2}{T} + \cdots + \frac{C_n}{T} = 1$

By the Law of Partial Pressures,

(3) $C_1 = ap_1$,

and by Raoult's Law,

(4) $p_1 = F_1 p_1^o$.

Combine (3) and (4) to obtain

(5) $C_1 = aF_1 p_1^o$.

Combining (1), (2.1) and (5), we obtain

(6) $$\frac{F_1 p_1^o}{T} + \frac{F_2 p_2^o}{T} + \cdots + \frac{F_n p_n^o}{T} = \frac{F_1 p_1^o}{T_1} + \frac{F_2 p_2^o}{T_2} + \cdots + \frac{F_n p_n^o}{T_n}$$

and solving for T,

(6.1) $$T = \frac{F_1 p_1^o + F_2 p_2^o + \cdots + F_n p_n^o}{\frac{F_1 p_1^o}{T_1} + \frac{F_2 p_2^o}{T_2} + \cdots + \frac{F_n p_n^o}{T_n}}$$

or $$\sum_{i=1}^{n} F_i p_i^o$$

(6.2) $$T = \frac{\sum_{i=1}^{n} F_i p_i^o}{\sum_{i=1}^{n} \frac{F_i p_i^o}{T_i}}$$

T = Threshold Limit Value in ppm.
C = Vapor concentration in ppm.
p = Vapor pressure of component in solution.
p^0 = Vapor pressure of pure component.
F = Mol fraction of component in solution.
a = A constant of proportionality.

Subscripts 1, 2, . . . n relate the above quantities to components 1, 2, . . . n, *respectively*.
Subscript i refers to an arbitrary component from 1 to n.
Absence of subscript relates the quantity to the mixture.

Solution to be applied when there is a *reservoir of the solvent mixture* whose composition does not change appreciably by evaporation.

Exact Arithmetic Solution of Specific Mixture

	Mol. wt.	Density	T	p^0 at 25°C	Mol fraction in half-and-half solution by volume
Trichloroethylene (1)	131.4	1.46g/ml	100	73mm Hg	0.527
Methylchloroform (2)	133.42	1.33g/ml	350	125mm Hg	0.473

$$F_1 p_1^0 = (0.527)(73) = 38.2$$

$$F_2 p_2^0 = (0.473)(125) = 59.2$$

$$T = \frac{38.2 + 59.2}{\frac{38.2}{100} + \frac{59.2}{350}} = \frac{(97.4)(350)}{133.8 + 59.2} = \frac{(97.4)(350)}{193.0} = 177$$

T = 177 ppm (Note difference in TLV when *account is taken of vapor pressure* and mol fraction in comparison with above example where such account is not taken.)

2. A mixture of one part of (1) parathion (TLV, 0.1) and two parts of (2) EPN (TLV, 0.5).

$$\frac{C_1}{0.1} = \frac{C_2}{0.5} = \frac{C_m}{T_m} \qquad C_2 = 2C_1$$

$$C_m = 3C_1$$

$$\frac{C_1}{0.1} = \frac{2C_1}{0.5} = \frac{3C_1}{T_m}$$

$$\frac{7C_1}{0.5} = \frac{3C_1}{T_m}$$

$$T_m = \frac{1.5}{7} = 0.21 \text{ mg/M}^3$$

1C. TLV for Mixtures of Mineral Dusts.

For mixtures of biologically active mineral dusts the general formula for mixtures may be used. With the exception of asbestos, pure minerals are assigned TLV of 2, 5, 20 or 50.

For a mixture containing 80% talc and 20% quartz, the TLV *for 100% of the mixture* "C" is given by:

$$\text{TLV} = \frac{1}{\frac{0.8}{20} + \frac{0.2}{2.5}} = 8.4 \text{ mppcf}$$

Essentially the same result will be obtained if the limit of the *more (most) toxic* component is used provided the effects are additive. In the above example the limit for 20% quartz is 10 mppcf.

For another mixture of 25% quartz 25% amorphous silica and 50% talc:

$$\text{TLV} = \frac{1}{\frac{0.25}{2.5} + \frac{0.25}{20} + \frac{0.5}{20}} = 7.3 \text{ mppcf}$$

The limit for 25% quartz approximates 8 mppcf.

APPENDIX C

BASES FOR ASSIGNING LIMITING "C" VALUES

By definition in the Preface, a listed value to which "C" designation refers to 'ceiling' value that should not be exceeded, all values should fluctuate below the listed value. In general the bases for assigning or not assigning a "C" value rest on whether excursions of concentration above a proposed limit for periods up to 15 minutes could result in a) intolerable irritation, b) chronic, or irreversible tissue change, *or c) narcosis of sufficient degree* to increase accident proneness, impair self rescue or materially reduce work efficiency.

T.L.V. RANGE ppm or mg/M³	Test T.L.V. Factor	Examples
0 to 1	3	Toluene diisocyanate - T.L.V. 0.02 ppm, if permitted to rise above 0.06 ppm may result in sensitization in a single subsequent exposure. "C" is recommended on category a.
1 + to 10	2	Manganese - T.L.V., 5mg/M³ contains little or no safety factor. All values should fluctuate below 5mg/M³. "C" is not recommended on category b.
10 + to 100	1.5	Methyl styrene - T.L.V. 100 ppm if encountered at levels 150 ppm will prove intolerably irritating. "C" listing recommended on category a.
100 + to 1000	1.25	Methyl chloroform - T.L.V. 350 ppm, at 438 ppm for periods *not exceeding 15 min.* is not expected to result in untoward effects relating to category c. No "C" listing recommended.

PERMISSIBLE EXCURSIONS FOR TIME-WEIGHTED AVERAGE (TWA) LIMITS

The last TLV Factor in the Table serves also as a guide to the magnitude of the permissible excursion above the limit for those substances not given a "C" designation i.e. the TWA limits. Thus for HF, with a TWA limit of 3 ppm, a concentration of 6 ppm is permissible for periods not exceeding 15 minutes, provided an equivalent exposure below the limit is experienced.

APPENDIX D

Some "Inert" or Nuisance Particulates [q]

Alundum (Al_2O_3)	Limestone
Calcium carbonate	Magnesite
Cellulose	Marble
Portland Cement	Pentaerythritol
Corundum (Al_2O_3)	Plaster of Paris
Emery	Rouge
Glycerine Mist	Silicon Carbide
Graphite (synthetic)	Starch
Gypsum	Sucrose
Vegetable oil mists (except castor, cashew nut, or similar irritant oils)	Tin Oxide
	Titanium Dioxide

[q] When toxic impurities are not present, e.g. quartz < 1%.

APPENDIX E

Some Simple Asphyxients - "Inert" Gases and Vapors

Acetylene	Hydrogen
Argon	Methane
Ethane	Neon
Ethylene	Nitrogen
Helium	Nitrous Oxide
	Propane

1969 TLV COMMITTEE MEMBERS

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1 – 49 Copies	50¢
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Documentation of Threshold Limit Values. A separate companion piece to the TLVs is issued by ACGIH under this title. This publication gives the pertinent scientific information and data with reference to literature sources that were used to base each limit. Each documentation also contains a statement defining the type of response against which the limit is safeguarding the worker. For a better understanding of the TLVs it is essential that the Documentation be consulted when the TLVs are being used.

Information concerning the availability of Xerox copies of the 2nd edition of the Documentation of Threshold Limit Values should be directed to the Secretary-Treasurer.

ERRATA

Page 6 — delete separate listing for n-Butyle acetate

Page 7 — the substance diazomethane and the corresponding TLV's of 0.2 ppm and 0.4 mg/M^3 should be listed independently. For the TLV of 1, 2 Diaminoethane, see Ethylenediamine

Page 13 — Teflon® decomposition products, appendix reference should be A^2.

COMMITTEE ON THRESHOLD LIMITS

of the

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS

1970 NOTICE OF INTENDED CHANGES*

This Notice of Intended Changes is published so that industry-connected individuals principally, but others also, may have an opportunity to help shape the deliberations of the Committee prior to its recommendations of tentative changes in the 1969 Threshold Limits List. This can be done by submitting to the Chairman comments on the intended changes, with supporting data, or by submitting new data on substances not within the Notice of Intent.

This Notice is not binding on the Committee to place all substances listed below in the 1970 Edition, nor does it restrict the Committee to these substances: substances with appropriate supporting data received following the publication of this list will be considered at the next Committee meeting for inclusion in the 1970 Edition. This Notice indicates only those substances that are under consideration by the Committee. As documentation becomes available, requests will be honored for those substances bearing a threshold limit value in this Notice. Those substances listed without a TLV originated from requests of the Committee during the year, but for which the Committee lacked information to recommend a TLV. Thus, such listings serve notice of the need for toxicologic information on these substances.

All comments should reach the Chairman by March 15, 1970. Address: Dr. Herbert E. Stokinger, U. S. Public Health Service, 1014 Broadway, Cincinnati, Ohio 45202. If preferred, information may be sent to the Repository of Anonymous Occupational Health Data, c/o Dr. R. T. P. deTreville, Industrial Hygiene Foundation, 5231 Centre Avenue, Pittsburgh, Pa. 15232.

The following list of Proposed Revisions and Additions for the 1970 Threshold Limits List has resulted from the fall meeting of the Plenary Committee.

REVISIONS UNDER CONSIDERATION

SUBSTANCE	FROM 1969 LIST	PROPOSED FOR 1970 LIST
Ammonia	50 ppm	25 ppm
Formaldehyde	C 5 ppm	C 2 ppm
Ammonium chloride	1	10 mg/m³
Asbestos	12 fibres/ml > 5μ in length	5 fibres /ml > 5μ in length
Camphor (synthetic)	2 mg/m³	2 ppm
Cotton dust (raw)	1 mg/m³	C 1 mg/m³
Mercury (organic compounds)		Mercury (alkyl)-Skin
Methyl chloride	C 100 ppm	100 ppm
'Inert' or Nuisance Aerosols	15 mg/m³	10 mg/m³ (or 30 mppcf, whichever is the smaller) of total dust <1% SiO_2. These limits apply to all other substances listed as 15 mg/m³ or 50 mppcf.

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ADDITIONS UNDER CONSIDERATION

SUBSTANCE	PROPOSED LIMIT
Benzonitril	--
Butyl lactate	1 ppm
Creosote	--
Cyclohexyl amine	--
2-N-Dibutylaminoethanol - Skin	2 ppm
Iron pentacarbonyl	0.01 ppm
Methylcyclopentadienylmanganese tricarbonyl	--
Permanganate	--
Potassium superoxide	--
Rosin fumes	0.1 ppm
Smoke and Fume (miscellaneous)	--
Subtilisin (proteolytic enzymes)	0.0005 mg/m^3
Triethylgallium	--
Triethylphosphine	--

INDUSTRIAL BIO-TEST LABORATORIES, INC.
[illegible]
[illegible]

Report on: HEALTH ASPECTS OF CAFCO C/F FIBERS

For: UNITED STATES MINERAL PRODUCTS COMPANY

Date: JUNE 4, 1970

ESTABLISHED 1935

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INDUSTRIAL HYGIENE FOUNDATION OF AMERICA, INC.

5231 CENTRE AVENUE PITTSBURGH, PA. 15232

Report on

HEALTH ASPECTS OF CAFCO C/F FIBERS

for

UNITED STATES MINERAL PRODUCTS COMPANY

by

ROBERT T. P. DE TREVILLE, M.D., SC.D.
President

PAUL GROSS, M.D.
Director of Research Laboratory

June 4, 1970

Introduction

This report deals specifically with the health effects of the type of mineral wool used by United States Mineral Products Company in sprayed fiber applications for fireproofing, insulating and acoustical purposes, derived entirely from blast furnace slag. Plants manufacturing this type of mineral wool are constructed on or near a slag site for economic reasons, i.e., to minimize costs of moving raw materials. The composition of the blast furnace slags produced in the United States are relatively similar, as will be described later, and there is no likelihood of introduction of a major source of contamination such as has been reported in regard to high manganese or vanadium containing slag from German steel furnaces. It would not be economically feasible either to import German slag or to introduce into use in the United States a steelmaking process having high content of manganese or vanadium, both considered critically short materials in this country; furthermore, quality control procedures used in the industry would reveal promptly presence of any such contamination of raw materials used. For these reasons, consideration need not be given herein either to high manganese or high vanadium containing blast furnace slag.

In addition, while glass wool finds increasing use in many building material applications today, its relatively low melting characteristics make it less suitable for fireproofing purposes, and there are today no commercially available sprayed fiber products composed of glass fibers.

Rock wool has been found less economical to use because of high weight loss (from CO_2 liberation from the limestone) during processing, so that for all intents and purposes, we may confine our attention herein to United States